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CONTENTS:

Hybridism in the Genus Viola, — III. *E. Brainerd* . . 49
New England Plants, — XVIII. Sphagnaceae. *A. L. Andrews.* 62
Plants of the Penobscot Valley. *O. W. Knight* . . . . . 65
Cytology of the Entomophthoraceae. *L. W. Riddle* . . . 67
A New Station for Asplenium ebenoides. *A. W. Smith* . . 68

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Rhodora

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# HYBRIDISM IN THE GENUS VIOLA, — III.

(Plates 66–70.)

Ezra Brainerd.

It is convenient to have some simple rule to determine the order in which the parent species shall be given in naming a hybrid; on the whole the alphabetical order adopted by the Old World botanists has most to recommend it. The eight hybrids discussed in Rhodora, vi. 213–223, thus amended, are as follows: —

1. Viola fimbriatula × septentrionalis.
2. V. cucullata × fimbriatula.
3. V. fimbriatula × sororia.
4. V. affinis × septentrionalis.
5. V. cucullata × septentrionalis.
6. V. septentrionalis × sororia.
7. V. affinis × sororia.
8. V. cucullata × sororia.

I would first add to this list three other Vermont hybrids,— the three possible combinations of *V. affinis*, *V. cucullata* and *V. nephrophylla*. A group of three thus interrelated we may speak of as a triad.

9. V. affinis × cucullata.— This differs from *V. affinis* in having larger leaves, in having a dark-blue ring around the center of the open corolla, in having long slender apetalous flowers, and in having long-auricled sepals; in these four respects it approaches *V. cucullata*. It differs from *V. cucullata* in having subacuminate leaves, in having purplish petals, in having a somewhat bearded spurred petal, and in having cleistogamous capsules dotted with brown; and in these four

respects it approaches *V. affinis*. It has all the characters common to the two parents — except fertility. One plant of this was found with the parents in an alder thicket along the Otter Creek in Middlebury in the spring of 1903, and has since been grown in the garden. It has spontaneously produced four seedlings quite like itself. It was not reported in November 1904, as it was a single instance, and the flowers had not been sufficiently studied. After watching it through the past season I have no further doubt regarding its origin.

10. V. AFFINIS × NEPHROPHYLLA.— Leaves and sepals noticeably less obtuse than in *V. nephrophylla*, even somewhat acuminate; capsules of cleistogamous flowers green speckled with brown, often with only withered ovules, rarely with over eight per cent fertilized. Numerous plants, growing with parent species, east shore of Providence Island, Lake Champlain.— The Vermont Botanical Club on its summer outing the last fourth of July visited this island, and found in the crevices of fractured limestone, below the high-water line, an abundance of *V. nephrophylla*. A little further back along a fringe of trees I collected a large clump of a strange violet, which I examined carefully only on my return home. Its sterility and unfamiliar aspect indicated a hybrid; its glabrous herbage, small ovoid cleistogamous flowers, and brown-dotted capsules could be accounted for only by assuming *V. affinis* as one of the parents. On July 22nd I revisited the station, found many other specimens of the hybrid, and *V. affinis* growing but a few feet away. Two hours' search on the island failed to disclose any other than these two species of blue stemless violet; I therefore venture to name it as above, though the petaliferous flowers are unknown.

11. V. CUCULLATA × NEPHROPHYLLA.— Quite intermediate between the parent species in those particulars in which they differ; especially in the length of the cleistogamous flowers and of the auricles of the sepals, characters in which the two species are in extreme contrast.— In September, 1904, eight or ten plants of *V. nephrophylla* were transferred to the garden from the borders of a cold brook running through Judge Munson's farm in Manchester, Vermont. When they flowered last spring, one of these plants was taller than the rest, more cespitose, had less obtuse leaves, and bore smaller flowers on longer peduncles. A few days later I revisited the Manchester station, and found occasionally similar plants, especially where in wetter places colonies of *V. cucullata* bordered those of *V. nephrophylla*. At

Arlington, twelve miles further south, in a boggy meadow where the two species grew together, I succeeded in finding another of these odd forms, seemingly a *V. cucullata* with violet flowers and bearded spur-petal. This Arlington plant was transferred to the garden, and this as well as the Manchester plant, as they developed through the summer, fully confirmed my suspicion as to their hybrid origin. They were both luxuriant and bore numerous cleistogamous flowers, that proved to be nearly sterile; I succeeded in getting only nine seeds for an experiment in sowing.

In the six following hybrids the parent species all belong to the *sagittata-cucullata* group, whose cleistogamous flowers are borne on erect peduncles and produce oblong green capsules clad with lanceolate long-auricled sepals. The species are all glabrous except *V. fimbriatula;* and all that occur in the eastern States have violet-purple flowers with a bearded spur-petal, except *V. cucullata.* They differ widely, however, in leaf outline, and thus have conspicuous characters that led to the early recognition of the five species, and that have also recently attracted attention to most of the intermediate forms resulting from hybridization.

12. V. SAGITTATA × SEPTEMLOBA.— This striking hybrid is figured in plate 66, a & b. It was collected by Mr. H. D. House at Hyattsville, Md., May 1 & June 8, 1905, growing with the parent species, and was recognized by him as a hybrid. I also regard as the same a plant in the Herbarium of the New York Botanical Garden, collected by Dr. Britton at Oakwood, Staten Island, N. Y., Sept., 1897, and labeled "*V. emarginata.*" It shows several quite sterile capsules, and its vegetative vigor is indicated by the added note, "plant one foot in diameter." Also in the National Herbarium is a specimen with leaves quite like those of the Hyattsville plant, collected by Wm. S. Davis, New Dorp, Staten Island, July 29, 1889, and labeled "*V. sagittata.*"

13. V. FIMBRIATULA × SEPTEMLOBA.— This was published as *V. Mulfordae* by Mr. C. L. Pollard (Proc. Biol. Soc. Wash., xv. 203.) and based on specimens collected by Miss F. A. Mulford at Hempstead Plains, Long Island, N. Y., May 13, 1902. Through the kindness of Miss Mulford, I received in September, 1904, ten or twelve plants of her violet, which have been under observation in the garden during the past season. They had the usual vigorous growth of hy-

brids, and produced numerous cleistogamous flowers, most of which, however, were quite sterile, turning yellow after a few weeks; in those that produced seeds the average number was $4\frac{5}{8}$. The intermediate character of the foliage is shown in plate 67 (fig. a) from a plant in cultivation September 13. The leaves of the parent species (figures b & c) are from herbarium specimens of plants growing with the hybrid and collected by Miss Mulford. Mixed with the live plants sent by her in September, 1904, were also five plants of *V. septemloba* and one of *V. fimbriatula*, showing that the three forms grew in close proximity to each other.

14. V. CUCULLATA × SAGITTATA.— I would so dispose of the colony of plants discovered by Mr. Witmer Stone, and described as *V. emarginata* (Tinicum, Pa., April 25 & June 21, 1903, Proc. Acad. Phila., 1903, p. 685). Last August I visited with him this station; the particular colony seen two years before had disappeared in a dense growth of briars and sprouts, after a recent chopping; but about 200 meters away a plant was found quite like those formerly collected, growing with what I regard as the parent species. These plants differ from the ordinary *V. emarginata* in having blue, not violet, petals (Mr. Stone says "between campanula blue and mauve of Ridgway"), in having on the spurred petal "scattered hairs" rather than a dense beard, and in having leaves with sharper coarser teeth at the base. The last character suggests *V. sagittata;* the two others, *V. cucullata.* The cleistogamous flowers in the August plant are also decidedly like those of the latter species, and the contour of the leaf is a fair compromise. The specimens of both collections show impaired fertility.

15. V. CUCULLATA × SEPTEMLOBA.— (*V. Brittoniana* × *cucullata,* House, Torr. Bull. xxxii. 255, pl. 17. *V. notabilis,* Bicknell, Torreya, iv. 131). I have had a specimen from Milltown, N. J., growing in the garden since June, 1904, and visited the station in August of that year. Mr. Bicknell's exact description and Mr. House's excellent drawing leave but little to be added. Mr. Stone also (l. c., p. 680) collected it at Springdale, N. J. in 1903, and surmised it then to be the hybrid here indicated. I place here also specimens of Mr. E. S. Steele, Berwyn, Md., May 15, 1902; and of Prof. Greene, Stony Run, Md., April 30, 1898.

16. V. CUCULLATA × (?) EMARGINATA.— This is probably the disposition to be made of Mr. Bicknell's *V. lavandulacea* (Torreya, iv. 130). The beautiful specimens sent me were collected at three

different dates in May, and were to me a puzzle until I saw last September a fine plant in the garden at Bronx Park. This was completely sterile; though there were fifty or more cleistogamous fruits, not a seed could be found. Its relationship to *V. cucullata* is evident, as Mr. Bicknell observes; its somewhat short and beardless spurred petal and elongated peduncles indicate this. The color of the petals, "pale lilac to lavender blue," is a modification in the direction of *V. emarginata*. The contour of the leaf and its slight pubescence is just such a compromise as might be expected from the union of *V. cucullata* with a modified form of *V. emarginata* like that described below (no. 29, B). Further study another season of the living plant may lead to more certain conclusions.

17. V. EMARGINATA × SEPTEMLOBA.— Aestival leaves simulating those of *V. palmata*, but quite glabrous; truncate at base or shallowly cordate; middle lobe disposed to be narrowly deltoid; autumnal and earliest vernal leaves but slightly incised; cleistogamous flowers on erect peduncles, producing green capsules 8–12 mm. long. The average number of seeds in 28 capsules was 14.36, showing about 80 per cent of unfertilized ovules.— Two good plates of this, drawn by Mr. Theo. Holm, are to be seen in Pittonia iii, pl. vii & viii. On page 256 Prof. Greene disposes of the plant as a "cut-leaved form" of *V. emarginata*, growing with the typical form that has "uncut trigonous foliage." I am under great obligation to Mr. Holm for a dozen live plants of these forms from Brookland, D. C., that I have grown for over a year; the hybrid shows remarkable vigor. Mr. House collected the same thing at Hyattsville, Md., June 4, 1905, no. 937. Mr. Witmer Stone also has it from Tuckahoe, Cape May, N. J., growing with both parents, Aug. 25, 1901 (Proc. Acad. Phila., Oct., 1903, pl. xxxvi, fig. v.); also *A. A. Heller*, near Beartown, Pa., June 8, 1901.

I pass next to speak briefly of eight hybrids between species of the *sagittata-cucullata* subgroup and those of the *affinis-palmata* subgroup. The latter have ovoid short-auricled cleistogamous flowers, on decumbent peduncles, and the capsules are usually reddish brown.

18. V. FIMBRIATULA × PALMATA Robinson in hb.— Aestival leaves ovate-oblong in general outline, acute or pointed, with one to three incised lobes on either side below the middle, clothed with minute soft pubescence; cleistogamous flowers intermediate between those of parent species; capsules somewhat dotted with brown, infertile.

"Crevices of rocks in open woods with parent forms," Granny Hill, Lexington, Mass., Sept. 20, 1903, *Robinson & Greenman.* Dr. Robinson first recognized and called my attention to this hybrid; last spring Dr. Greenman kindly procured for me about twenty living plants; I visited the station in August. The leaves vary considerably in relative width and in lobation, as do those of *V. palmata*; and those produced in late summer and autumn are often uncut or slightly lobed, as though anticipating the earliest vernal leaves. Additional stations are: "pastures," Portsmouth, N. H., July 15, 1894, *Charles A. Davis;* "moist woods under pines," Kensington, N. H., July 2, 1899, *A. A. Eaton;* Niles Place, Ledyard, Conn., June 24, 1900, *Mrs. C. B. Graves;* East Lyme, Conn., 1904 & 1905, several colonies, *Miss A. M. Ryan.* (See pl. 70.)

19. V. FIMBRIATULA × PAPILIONACEA.—(*V. papilionacea aberrans* Stone, l. c., p. 683, pl. xxxvii, fig. 4–6). This is hardly distinguishable from hybrid no. 3 (RHODORA, vi. 215). *V. sororia* is separated from *V. papilionacea* chiefly by pubescence; but both hybrids inherit pubescence from *V. fimbriatula,* and the other parent must be determined chiefly from its presence with the hybrid. No. 19 seems to occur frequently along the Atlantic border.

20. V. PALMATA × SAGITTATA.— Differs from *V. sagittata* in having wider pubescent leaves, more or less lobed near the middle, in having cleistogamous flowers with appressed ciliate auricles, and in having a brown-spotted summer capsule on much shorter peduncles. It differs from *V. palmata,* var. *dilatata* in having ovate-oblong leaves with coarsely toothed or incised basal lobes, and in having long slender cleistogamous flowers on ascending peduncles. In each case the departure is in the direction of qualities possessed by the other parent. The autumn leaves are cordate and uncut; capsules few-seeded — nineteen in the four capsules examined; both parent species near by. — This hybrid was collected by Mr. House in May and June, 1904, near New Brunswick, N. J., nos. 39, 53, 68. I have had a specimen in the garden since June 15, 1904, and have twice visited the station. I place here also two specimens in the Gray Herbarium: Centreville, Del., May 19, 1877 and Oct. 27, 1878, *A. Commons;* near Garrison's, N. Y., May, 1886, *Ed. S. Denton.* The last has a more deeply cut leaf than the two others, as though from typical *V. palmata;* Dr. Gray has written on the sheet "V. palmata, L toward sagittata."

21. V. PAPILIONACEA × SAGITTATA.— Not unlike the last described

hybrid, but quite glabrous and without lobes. Ivy Hill Cemetery, Philadelphia (June, 1905, Mr. Stone sent living plants now in garden). Sept. 6, 1905, *Stone & Brainerd*; along railway near Lester Sta., Tinicum, Pa., Sept. 6, 1905, *Stone & Brainerd*; near New Brunswick, N. J., Sept. 7, 1905, with both parents, *Brainerd*; Curtis Street, Southington, Conn., May 28, 1899, *C. H. Bissell*, named by Mr. Pollard, "*V. sagittata*, rank development"; roadside, East Lyme, Conn., Aug. 29, 1905, *Miss A. M. Ryan*.— The rank cespitose growth of the hybrid is shown by the fact that eleven ample specimens were made from one of the New Brunswick plants. In four capsules of the Ivy Hill plant the number of seeds averaged 29; the plants from the other stations are less fertile. The capsules of the Ivy Hill plants are nearly green in color, those of New Brunswick brown-spotted; but the capsules of *V. papilionacea* at these two stations differ in like manner.

22. V. AFFINIS × SAGITTATA.— Leaves narrowly deltoid, the upper half minutely and distantly serrate, the basal lobes rounded and coarsely toothed, forming a broad sinus; cleistogamous flowers and fruit intermediate. From two stations: Patuxent, Md., June 4, 1905, *H. D. House*, no. 972; Tinicum, Pa., Sept. 6, 1905, *Stone & Brainerd*.— With the Patuxent specimen was mixed a plant of *V. affinis*, the form with minutely pubescent capsules; it was interesting to see that the capsule of the hybrid had also this mark, which is not found in any other species of our blue stemless violets. The Tinicum plant was discovered at Mr. Stone's station for *V. crenulata*, Greene, a phase of *V. affinis* found in open bogs; and *V. sagittata* grew at no great distance.

23. V. PALMATA × SEPTEMLOBA.— Differs from *V. septemloba* in the direction of *V. palmata*, in its large less divided leaves with broad middle lobe, in pedicels one half as long, in bearing pubescence on petiole and veins of leaf, and in having summer capsule dotted with brown; differs from *V. palmata* in the direction of *V. septemloba*, in being less pubescent, in producing slim long-auricled cleistogamous flowers on ascending pedicels, in having nearly green cleistogamous capsules.— Discovered at Milltown, N. J., by Mr. House in June, 1904. A live plant sent at that time has attained to a large size in the garden. About one fifth of the ovules mature into seeds; the leaves in late summer become ranker and less divided.— In March, 1904, I noticed in the National Museum two sheets of what seemed to be this hybrid from Stratford, Conn., May 24, 1893, *E. H. Eames*. The

specimens are nearly glabrous, except one smaller plant — good *V. palmata*. Dr. Eames writes that he remembers the plant as "a connecting link between *V. palmata* and *V. Atlantica*" (*V. septemloba*), both of which grew there. He adds, "I avoided the intermediates in order to have something I could name." The station has been much disturbed, but I trust that these "avoided" plants may yet be rediscovered.

24. V. CUCULLATA × PALMATA.— Among the living plants sent by Dr. Greenman from Granny Hill, Lexington, was one that, as it developed during the past summer, I could account for only in this way. It was extremely sterile, but produced numerous slender cleistogamous flowers, like those of *V. cucullata* × *sororia* (no. 8). The leaves were somewhat three-lobed, the *V. palmata* present being the "var. *dilatata*." On visiting the station, I observed, perhaps 100 meters away, in a marshy meadow at the base of the hill, plants of *V. cucullata*. Miss A. M. Ryan the past summer found the same hybrid in several places in East Lyme, Conn.

25. V. CUCULLATA × PAPILIONACEA.— Much like the last and no. 8 in its sterile subulate cleistogamous flowers, that are usually tinged with brown; but different from both in being quite glabrous and from no. 24 in showing no trace of lobes.— Southington, Conn., transplanted to garden by *C. H. Bissell*, seen by me Aug. 22, 1905; East Lyme, Conn., 1905, *Miss A. M. Ryan*. Its luxuriant growth in cultivation one season was such that from one plant twenty large specimens were made by Miss Ryan for distribution. Found also in a low woods on the line between New York and Yonkers, Sept. 8, 1905, *Eggleston & Brainerd*.

Two hybrids of *V. villosa* with closely related species should be here noticed.

26. V. PALMATA × VILLOSA.— Looks like small plants of *V. palmata*, var. *dilatata* with the silvery pubescence of *V. villosa* on the upper surface of the leaves.— I am indebted to Mr. House for the recognition of this hybrid: Milltown, N. J., June 19, 1904; Darlecarlia Reservoir, D. C., June 17, 1905, no. 1030; Rock Creek Park, D. C., May 13, 1905, no. 712. The same thing occurs at Ivy Hill Cemetery, Philadelphia, and was pointed out to me by Mr. Stone last September.

27. V. AFFINIS × VILLOSA.— Much of what Mr. Stone, (l. c., p.

674,) has included under *V. villosa cordifolia* seems to be this. Both supposed parents were abundant in 1903 at the Sherwood station in a dry woodland; but the trees have since been cut.

It remains to speak of several cases in which unlike forms are produced by the crossing of two doubtfully distinct species.

28. V. FIMBRIATULA × SAGITTATA.— The most conspicuous distinctions between these two species are found in the foliage. They may be thus stated: pure *V. sagittata* has narrower leaves, dilated and incised basal lobes, longer petioles, and is glabrous; (cf. fig. c of pl. 66 with fig. c of pl. 67). The progeny of the cross instead of presenting a halfway state between these divergent characters, is often quite like one parent in some of these features and quite like the other parent in other features. Thus in this particular cross we have four groups of forms:

A. The breadth of leaf of *V. fimbriatula* and the glabrous surface of *V. sagittata*. (See pl. 68, fig. c.)
B. The leaf-outline of *V. sagittata* and the pubescence of *V. fimbriatula*. (Fig. d.)
C. A compromise in leaf-outline, forming a deltoid leaf, either with incised lobes at the base (fig. a.), or without (fig. e.), and with either much or little pubescence.
D. The lower half of the leaf may be broad and the upper half abruptly narrowed (fig. b.), and this either with incised lobes at the base or without, and with a varying amount of pubescence.

In this plate only a few of the variant forms are given. One needs to visit a station where hundreds of specimens can be seen to appreciate this tendency to sport. A fine station for this was discovered by Miss Ryan, on the north side of a railway embarkment across a salt marsh, at Giant's Neck, East Lyme, Conn. The plants, or their seeds, were evidently brought there with the soil, and no other violets were found there. Other stations are: "Gristmill Park," Plainville, Conn., *Luman Andrews*, 1904; Blue Hill Reservation, Milton, Mass., *H. A. Purdie;* Lindenau, near New Brunswick, N. J., *H. D. House.* — Various forms have been seen from other stations, but I have visited only the four above named. In all these forms there is little or no impaired fertility.

29. V. EMARGINATA × FIMBRIATULA.— Here we have a similar

case, though of rarer occurrence. In September, 1904, I received from Mr. Theo. Holm a package of about fifteen live plants, which he called the Washington form of *V. fimbriatula.* As they developed during the past summer, they all manifested a mixture of the characters of *V. emarginata* and *V. fimbriatula,* and yet could be easily marked off into four classes, as follows:

A. Leaves somewhat deltoid as in *V. emarginata,* quite coarsely toothed at base, margins ciliate, base truncate or in the larger leaves slightly cordate, petioles sparingly pubescent; most capsules completely sterile, one yielded ten seeds.
B. Leaves ovate-oblong as in *V. fimbriatula,* obscurely serrate, margins and petioles pubescent, base strongly decurrent,— entire outline suggesting that of *V. primulifolia:* capsules many and all fertile.
C. Leaves deltoid, ciliate, truncate, with sinuately toothed margins; capsules numerous, fertile, 16–20 mm. long.
D. Leaves ovate-oblong, truncate, ciliate; capsules fertile, 8–12 mm. long.[1]

30. V. EMARGINATA × SAGITTATA.— Between these two glabrous species the only difference is in leaf-outline. Marked intermediates have been observed, without loss of fertility.— Chester Co., Pa., colony no. 18, June 21, 1903, *W. Stone,* l. c., p. 685; Brookland, D. C., Sept. 28, 1904, *Theo. Holm* (I have grown several plants of this the past season); along the Raritan R. R., Milltown, N. J., Aug. 20, 1904, *Eggleston & Brainerd,* associated with both parents and apart from *V. fimbriatula.*

*V. palmata, V. papilionacea,* and *V. sororia* furnish another triad quite analogous to that just described. These common species, however different in extreme instances, especially when found outside of each other's range, seem to be confluent when growing together. No sharp line can be drawn between *V. sororia* and *V. papilionacea*; I find many plants of the Middle States that seem quite like the *V. sororia* of Vermont, but they are usually called "pubescent *V. papilionacea,*" "entire-leaved *V. palmata,*" or sometimes *V. laetecaerulea;* much of the Vermont *V. sororia* Mr. Pollard used to name *V. papilionacea. V. palmata* also, passes through the polymorphous phases of its "var. *dilatata*" into both *V. sororia* and *V. papilionacea.* In

[1] I anticipate that some will prefer to consider this a case of "mutation"; perhaps it is,— one's interpretation of facts is so apt to be determined by his predisposition of mind.

none of the forms of this triad have I observed any sign of impaired fertility. Some of this intergradation may be due to the imperfect evolution of the three species, the links ordinarily missing being in this instance still extant; but I have no doubt these species can and do interbreed.

I will speak of only one other instance of confluence, and I am indebted for this to the acute observation of Mr. F. F. Forbes of Brookline, Mass. He has discovered on "Dedham Island," along the Charles River, a station for *V. pectinata*, Bicknell (Torreya, iv. 129, Sept., 1904). The type is from Long Island; but Mr. House also, found it, in May, 1904, near Dayton, N. J. (Bull. Torr. Club, xxxii. 255, pl. 18), and Dr. C. C. Godfrey, in June, 1905, at Stratford, Conn. The species is, to me, distinguishable only by the configuration of the leaf from *V. septemloba*, with which it is associated in all four stations.[1] At "Dedham Island" Mr. Forbes found that the two plants passed, by the most gradual stages, one into the other. I visited the station last May and again last August, and found the plants abundantly spread over a large territory, and showing no sign of impaired fertility. Plate 69 presents the two extreme leaf-patterns and some of the intermediates. Often they closely simulate the leaf of *V. cucullata* × *septemloba* (no. 15); but that is a larger plant, with infertile capsules and dark-brown seeds, due to the black seeds of *V. cucullata;* the seeds of *V. septemloba, V. pectinata* and their intermediates are of a light straw color.

The accompanying diagram presents a bird's-eye view of these hybrids and their parentage. Though the forms are perplexingly numerous, only half of the possible sixty-six hybrids have been brought to light. Others will doubtless be discovered. Moreover, still further complications may be expected; we may find quarter or eighth hybrids, produced by crossing a simple hybrid once, or twice, with one of the parent forms; or we may find triple or quadruple hybrids, produced by crossing a simple hybrid with an allied species other than the parents, or with another hybrid. Some of the hybrids of *V. palmata* × *sagittata* (no. 20) at New Brunswick are very likely not from pure *V. sagittata* but from the *V. fimbriatula-sagittata* combination,

[1] It will be helpful to our understanding of the relations of *V. septemloba* to *V. pectinata*, if we observe the exactly parallel relation of *V. pedatifida* to *V. indivisa*, Greene (Pittonia v. 124, pl. xiii.). The variation of *V. palmata* into *V. Bernardi*, Greene is a movement in the same direction, though not to the same extent.

that is more common at that station. Again, a *V. palmata* parent may have more or less admixture of *V. sororia* or *V. papilionacea*. Miss Day, librarian of the Gray Herbarium, has kindly called my attention to an account of the discovery in the Tyrol, near Innsbruck, of a genuine triple hybrid: *Viola* (*hirta* × *odorata*) × *collina*. (See Magyar Bot. Lapok. ii. 180, June, 1903.)

Middlebury College.

Explanation of Plates 66–70.

Pl. 66, figures a & b, *Viola sagittata* × *septemloba* (*H. D. House*, Hyattsville, Md.).
figure c, *Viola sagittata*, } collected at the same time and place with
figure d, *Viola septemloba*, } "a."

Pl. 67, figure a, *Viola fimbriatula* × *septemloba* (*Miss F. A. Mulford*, Hempstead, Long Island, N. Y.); grown one year in Middlebury, Vt.
figure b, *Viola fimbriatula*, } both from the same station as "a."
figure c, *Viola septemloba*, }

Pl. 68, figure a, *Viola fimbriatula* × *sagittata* (*Miss A. M. Ryan*, East Lyme, Conn.).
figures b to e, Leaves of other plants of this cross from same station

Pl. 69, figure a, Leaf of *Viola septemloba*, }
figure f, Leaf of *Viola pectinata*, } (*F. F. Forbes*, Dedham, Mass.).
figures b to e, intergradient forms, }

Pl. 70, figure a, Leaf of *Viola fimbriatula*, }
figure b, *Viola fimbriatula* × *palmata*, } *Robinson & Greenman*, Granny Hill, Lexington, Mass.
figure c, Leaf of *Viola palmata*, }

In all five plates the figures are × $\frac{7}{8}$.

## EXPLANATIONS OF DIAGRAM.

At the bottom of the diagram the names of the twelve species are arranged according to their natural affinity, so far as this can be done in a lineal series. The squares above indicate the sixty-six possible hybrids of these species, the parent species in each case being those included between the sides of the square produced downward to the right and to the left.

The double line indicates the division into subgroups; the heavy lines separate quite distinct species; the broken lines, doubtfully distinct species. The hybrids are numbered as in the text of the article.

—The asterisks indicate the number of stations in which the hybrid has been found, if five or less; if more, the sign + is added.

—The name in any square is that under which the hybrid has been already published, as a species or variety.

—The letters N. C. indicate that the two species are not cohabitant, so that a natural hybrid is not likely to occur.

– The interrogation point denotes plants suspected to be hybrids.

—The sign # denotes variable crosses, resembling the hybrids of Mendel.

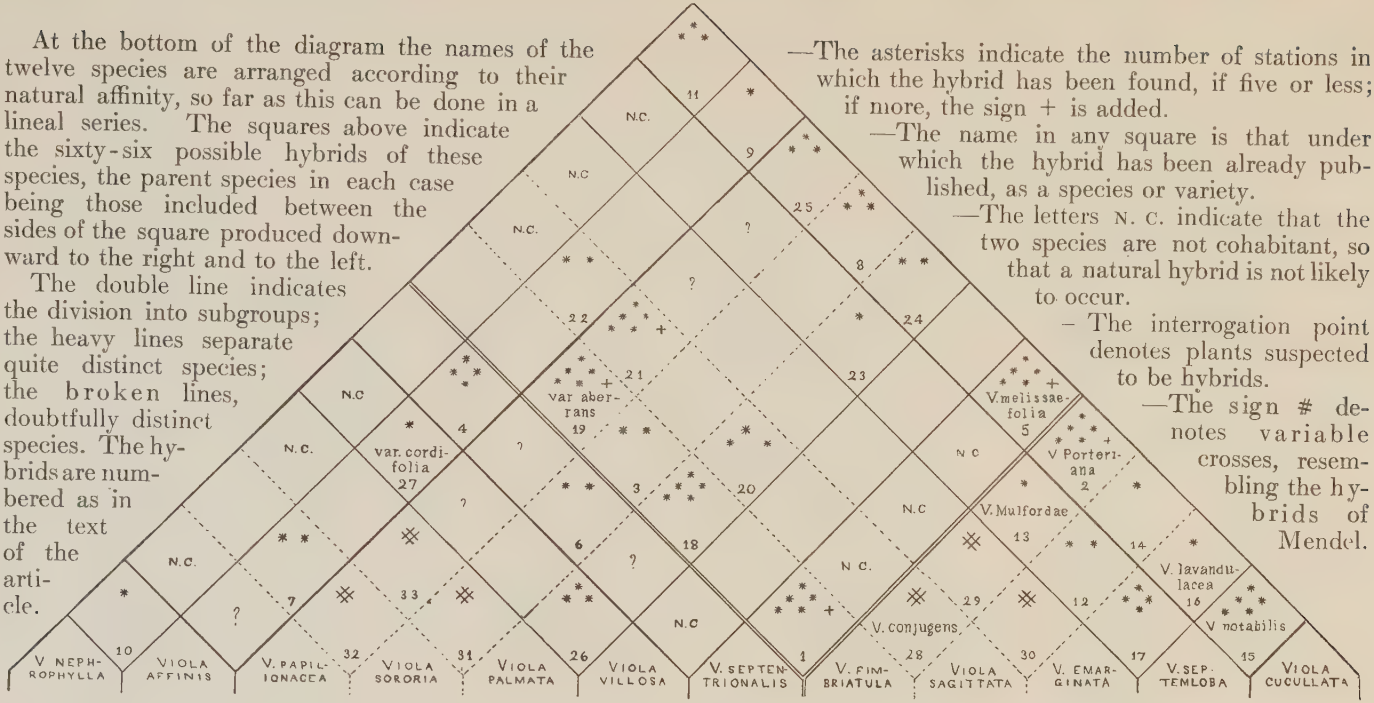



DIAGRAM SHOWING RECOGNIZED AND POSSIBLE HYBRIDS OF TWELVE SPECIES OF VIOLA.

# PRELIMINARY LISTS OF NEW ENGLAND PLANTS, — XVIII. SPHAGNACEAE.[1]

A. LeRoy Andrews.

**[The sign + indicates that an herbarium specimen has been seen; the sign — that a reliable printed record has been found.]**

| | Me. | N. H. | Vt. | Mass. | R. I. | Conn. |
|---|---|---|---|---|---|---|
| Sphagnum acutifolium Ehrh. | + | + | + | + | + | + |
| " auriculatum Schpr. | + | | | + | | |
| " compactum DC. | + | | | | + | |
| " " var. squarrosum Russ. | + | | | + | | |
| " contortum Schultz. | | + | | + | + | + |
| " cuspidatum Ehrh. | + | | + | + | + | + |
| " " var. falcatum Russ. | + | | | + | | + |
| " " var. Miquelonense R. & C. | + | + | + | + | + | + |
| " " var. plumosum Bryol. Germ. | + | | | + | | + |
| " " var. Torreyanum (Sull.) Braithw. | | | | + | | |
| " cymbifolium Ehrh. | + | + | + | + | + | + |
| " " var. squarrosulum Bryol. Germ. | + | + | | + | | + |
| " dasyphyllum Warnst. | | | | | | + |
| " Dusenii C. Jensen | — | + | | | | |
| " fimbriatum Wils. | + | + | | + | | + |
| " " var. squarrosulum H. Müll. | | | | + | | |
| " fuscum (Schpr.) von Klinggr. | + | + | + | + | | + |
| " Garberi L. & J. | + | | | | | |
| " Girgensohnii Russ. | + | + | + | + | | + |
| " " var. coryphaeum Russ. | + | + | — | + | | |
| " " var. molle Russ. | + | + | | + | | |
| " imbricatum Hornsch. | — | + | | + | + | + |
| " " var. affine (R. & C.) Warnst | + | + | | + | + | + |
| " " var. sublaeve Warnst. | + | + | | + | + | + |
| " inundatum Russ. | + | + | | + | | |

[1] This list was mailed to me shortly before Mr. Andrews sailed for Europe. At his request I have inserted dashes to indicate such available printed records as related to the species and varieties mentioned in his list. Aside from these few insertions the list remains unchanged. — J. Franklin Collins.

[1] Printed in Rhodora as supplementary matter.

| | Me. | N. H. | Vt. | Mass. | R. I. | Conn. |
|---|---|---|---|---|---|---|
| Sphagnum Lindbergii Schpr. | | + | | | | |
| " macrophyllum Bernh. | | | | | + | |
| " medium Limpr. | + | + | + | + | + | + |
| " molle Sulliv. | + | | | | | |
| " molluscum Bruch. | + | | | | | |
| " obesum Wils. | | — | | + | + | + |
| " papillosum Lindb. | + | + | | | + | |
| " platyphyllum Sulliv. | | | | + | | + |
| " plicatum Warnst. | | | | + | | |
| " pulchrum (Lindb.) Warnst. | + | + | | | | |
| " Pylaiei Brid. | + | + | | | | |
| " quinquefarium (Braithw.) Warnst. | + | + | + | | | |
| " recurvum Beauv. | + | + | | + | + | + |
| " " var. amblyphyllum Russ. | + | + | + | + | + | + |
| " " var. parvifolium (Sendt.) Warnst. | + | + | + | + | + | |
| " riparium Ångstr. | | + | | | | |
| " rubellum Wils. | + | + | + | + | | + |
| " rufescens Bryol. Germ. | + | + | | + | + | + |
| " Russowii Warnst. | + | + | + | | | |
| " squarrosum Pers. | + | + | + | + | | |
| " subnitens Russ. & Warnst. | + | — | | | | |
| " " var. flavicomans (Card.) Warnst. | + | | | + | | + |
| " subsecundum Nees. | + | + | + | + | + | + |
| " tenerum (Aust.) Warnst. | + | + | + | + | + | + |
| " teres (Schpr.) Ångstr. | + | + | + | + | | |
| " " var. squarrosulum (Lesq.) Warnst. | + | + | + | | | |
| " Warnstorfii Russ. | + | + | + | — | | + |
| " Wulfianum Girgens. | + | + | + | | | |

## Notes on the Preceding List.

The above list is based essentially upon the latest treatment of Warnstorf (Kryptogamenflora der Mark Brandenburg und angrenzender Gebiete, Bd. I, Leber- und Torfmoose, C. Warnstorf, Leipzig, 1903. Sphagna Ss. 292–467), which considers the Sphagna of Europe. Nearly all of the New England species are common to Europe. This recent work differs from Warnstorf's earlier treatment of North American forms (Contributions to the Knowledge of North American Sphagna, Bot. Gaz., Vol. 15, 1890, pp. 127–140, 189–198, 217–227, 242–255), with later scattered descriptions collected in

Barnes and Heald's Keys, in the fact that several forms there treated as varieties have been elevated to specific rank. In the treatment of species I have differed in the following points: *S. subbicolor* Hampe (*S. intermedium* Russ., *S. centrale* C. Jens.) I have not been able to separate satisfactorily from the forms of *S. cymbifolium.* It is placed between this species and *S. papillosum,* having walls of hyaline cells of branch leaves smooth as in *S. cymbifolium,* but differing slightly in shape and position of chlorophyllose cells, a matter however of considerable variability in this group as Röll has pointed out. I have seen New England specimens referred to it. *S. parvifolium* (Sendt.) Warnst. I have retained in its former place as a variety of *S. recurvum. S. Torreyanum* Sull. and its variety *Miquelonense* I have in the same way retained with *S. cuspidatum.* With reference to the varieties which have been named in such numbers in this genus I have included such as appear to show a distinct and readily recognized variational tendency, upon which various authors show general agreement. In so doing I have omitted varieties based upon the presence of a greater or less amount of coloring pigment, relative slenderness or compactness of the plant, direction of the branches, and other characters possibly explainable as due to immediate environment of the plants, calling for an arbitrary delimitation, and of questionable systematic value. In case a species has been exhausted by varieties so that no form appears to remain under the head of the species, as in *S. imbricatum,* I have omitted the variety corresponding with the original conception of the species, in this case var. *cristatum* Warnst. In the same way I have included var. *mucronatum* Russ. with its species *S. recurvum.*

If the list emphasizes the fact that the New England species, or for that matter the American species of Sphagnum, are in need of extensive collection and study, it will have served its purpose. A very little collecting in Vermont should serve to fill many gaps in the list, while the same is true in hardly less degree of the other states. Especially do the questionable aquatic forms need particular attention. The status of the species, especially in the subsecunda group, can hardly be regarded as settled, and also demands the attention of the collector.

In addition to the species included in the list the following European forms may be looked for in New England with a prospect of success; *S. Ångstroemii* Hartm., a very distinct species of high latitudes, may possibly be found on the mountains of the northern states. It has recently been collected in America, a specimen kindly com-

municated by Warnstorf bearing the label, Hunker Creek, Yukon, J. Macoun, '02. From the cuspidata group the following are to be noted: *S. monocladum* (v. Klinggr.) Warnst., *S. Trinitense* C. Müll. (known from Florida), *S. fallax* v. Klinggr., *S. obtusum* Warnst., *S. Balticum* Russ., *S. Schultzii* Warnst., *S. hypnoides* (A. Braun.) Bruch, *S. annulatum* Lindb. fils; from the acutifolia group *S. subtile* (Russ.) Warnst.; from the subsecunda group *S. crassicladum* Warnst., *S. turgidulum* Warnst. Furthermore several species of southern United States range occurring as far north as New Jersey, mostly members of the cymbifolia and subsecunda groups, may be sought in the coast-region of Connecticut and Rhode Island. The specific value of most of the latter segregates can hardly be regarded as determined without more extensive collections.

With reference to the record of localities from which specimens were not seen Mr. J. F. Collins has very kindly examined the local list and the — signs in the above list are to be accredited to him.— A. LeRoy Andrews, Berlin, Germany.

## SOME NOTEWORTHY PLANTS OF THE PENOBSCOT VALLEY.

Ora W. Knight.

*Lilium tigrinum* Ker. Growing along the roadside remote from houses in Holden, three stations being known for several years.

*Allium schoenoprasum* L. A station, discovered by Mr. F. M. Billings and myself, along the Penobscot River, near Veazie, is the only one we have found in this region.

*Cypripedium arietinum* R. Br. Hundreds of plants were in bloom on a steep hillside in rich mixed growth in the town of Bucksport, where Mr. F. M. Billings, Mr. Norman Hall and I found them May 20, 1904.

*Populus dilatata* L. Along the banks of the Penobscot River in Veazie, and not near any cultivated grounds, several hundred square feet are covered by a growth of this species ranging from small shoots to good sized trees. Seemingly all are connected at the roots.

*Castanea sativa americana* Gray. In 1904 I found a good sized tree of the chestnut growing near the roadside in a beech and oak

growth in the town of Holden, and on July 28 collected flowering specimens. This was not near any house or cultivated land and had no evidence of being put there by the hand of man.

*Polygonum zuccarinii* Small. A small clump has persisted near the roadside on Stillwater Ave., town of Orono, for several years and does not appear to be growing under conditions which would indicate anybody planted it there.

*Conringia perfoliata* Link. Collected by me along the water front, Bangor, July 4, 1904.

*Polygala paucifolia,* forma **albiflora.** Whole plant much paler than the typical form of this species and the blossoms white. This albinistic form grows very abundantly in an extensive tract of open woods and pasture land in Bangor, forming extensive carpets of plants and bloom. A few plants of the normal form grow scattered through the same territory.

*Mimulus moschatos* Dougl. Mr. F. M. Billings brought me a plant of this species which he collected on ballast along the water front, Bangor, July 28, 1904.

*Teucrium boreale* Bicknell. I collected a number of plants in bloom which I took for our common Teucrium, and which were growing in a meadow near Stillwater Avenue just within the limits of Orono, August 10, 1904. Thinking them the common species I did not take so many as I otherwise would have. Professor Fernald pronounces my specimens to be as above. The same locality was closely watched during 1905, and though hundreds of small plants were seen, only two showed bloom and these only a very few buds and flowers. The previous year all the plants were tall, lusty and full of bloom. Can it be that this species is biennial?

*Tragopogon porrifolius* L. I have a specimen collected in a field in Stillwater (Oldtown), July 5, 1903, by Mr. Billings.

*Tragopogon pratensis* L. I have specimens from both Orono and Bangor. The Bangor plants are well established along a roadside within the residential portion of the city and have been persistent for several years.

*Lychnis flos-cuculi* L. Though not growing in the Penobscot valley this seems good opportunity to record finding this species not far distant in the town of Pittsfield. It has been established several years and when I saw it in June, 1905, covered many acres of fields with a mass of bloom.

Bangor, Maine.

# CONTRIBUTIONS TO THE CYTOLOGY OF THE ENTOMOPHTHORACEAE: PRELIMINARY COMMUNICATION.

Lincoln Ware Riddle.

For the past two years the writer has been engaged in a study of the cytology of certain species of *Empusa* and of *Entomophthora*. One species of *Empusa* and four species of *Entomophthora* have been examined.

It has been found that the nucleus of *Entomophthora* has a highly developed structure, showing little resemblance to the nucleus of the Yeast, as Cavara suggested. Further the nucleus of *Entomophthora* undergoes a more or less typical mitotic division. The resting-nucleus shows a rather small nucleolus surrounded by a densely granular chromatin-content, which may at times appear as a network. During prophase the chromosomes (of which there are 8 in *E. Americana*) are formed by the direct aggregation of the chromatin-granules, without the intervention of a spireme-stage. This drawing together of the chromatin leaves evident a number of linin-fibers, running from the spherical chromosomes to the nuclear-wall which persists throughout mitosis. These linin-fibers gradually separate into two groups which draw toward the respective poles, forming a typical, intranuclear bi-polar spindle. No centrosomes were seen in any case. The so-called nucleolus appears to be strictly a karyosome, as it is identical with the chromosomes in appearance and behavior during division. The later phases of mitosis are much as in other cases.

The nuclear details of zygospore-formation agree essentially with those described by Gruber for *Sporodinia*; and the process in general shows a close agreement with conditions in the Mucorales. The zygospore either buds out at the point of fusion of the hyphal bodies (compare the conditions in *Piptocephalis*) or else buds out from one of the gametes (compare the conditions in *Syncephalis nodosa*). In either case the fusing hyphal bodies are multinucleate structures and are therefore coenogametes — a type of sexual organ shown by Davis and others to be characteristic of the Phycomycetes. The entire contents of both gametes, including all of the nuclei, pass into the young zygospore. No fusion of the nuclei occurs during the first

three months. Whether or not fusion in pairs occurs at the time of germination, as we should expect, it has been so far impossible to determine, owing to the difficulty of germinating the zygospores.

The formation of the azygospores in *Empusa* was found to present conditions quite different from those described by Vuillemin for *Entomophthora gleospora*. In the case of *Empusa* the entire contents of the hyphal body, including all of the nuclei, which may number over 40, pass into an ampulla which is cut off, forming the azygospore. No further changes take place in these nuclei so far as has been observed. The writer offers the suggestion that this structure is in the nature of a chlamydospore, a view which is further supported by the fact that an encysted hyphal body, as a means of tiding over the winter, may frequently be substituted for the usual azygospore.

The cytological conditions show that *Entomophthora* is a more highly developed genus than *Empusa*. The general results here described bring these genera into complete accord with the conditions known in other *Phycomycetes*. The complete paper presenting in full the evidence for the statements here made is now in preparation.

Harvard University.

---

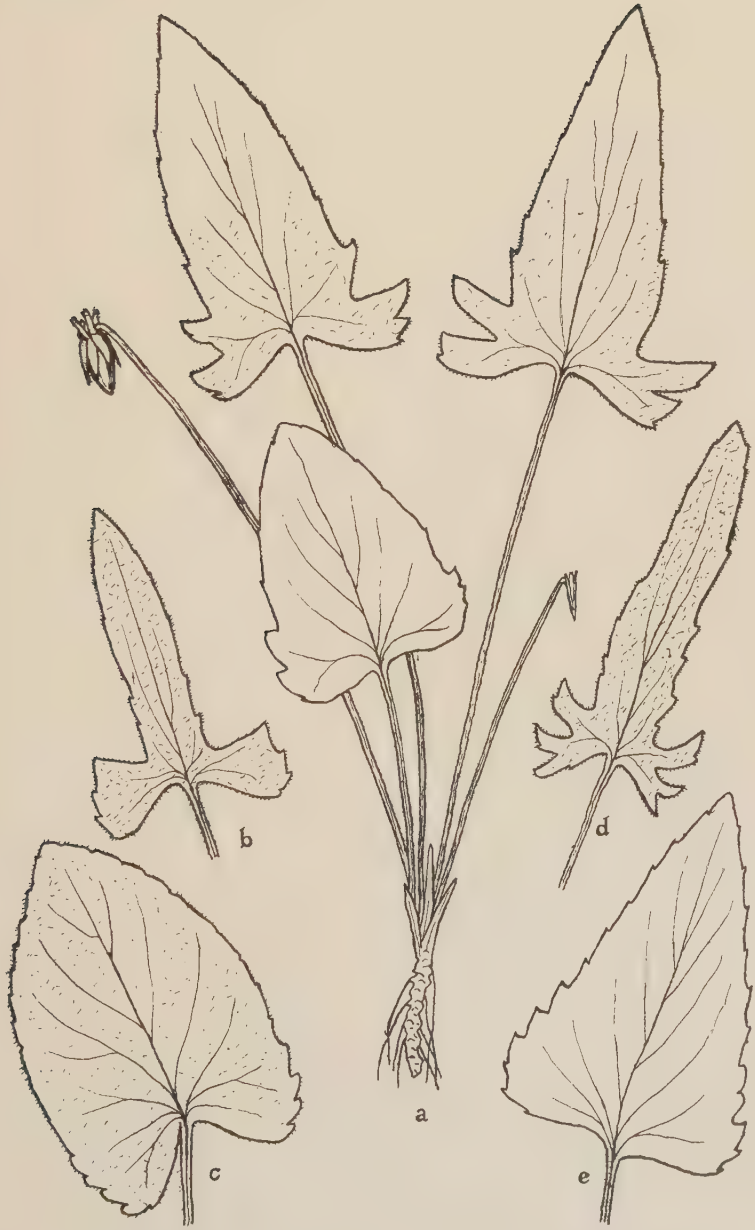
A new Station for Asplenium ebenoides.— Just outside the town of Salisbury, Vermont, there is, a few feet from the roadside, an open grove of trees, surmounting an out-cropping ledge of limestone. On this ledge I found *Asplenium ebeneum* and *Camptosorus rhizophyllus* in abundance, but search failed to discover *Asplenium ebenoides* among them. About fifty feet away, however, in the open pasture the limestone again jutted out, and here I found a large plant of *A. ebenoides*, from which a frond was sent to the Gray Herbarium where the identification was confirmed. A smaller plant some five feet away and still a third, very small and just assuming shape, were found. *A. ebeneum* grew profusely upon this rock, but I found only a few inferior plants of the walking-leaf.— Anna W. Smith, West Brattleboro, Vermont.

[It is believed that the locality, here reported by Miss Smith, is by a few miles the most northern station for *A. ebenoides* as yet recorded, at least in New England.— Ed.]

*Vol. 8, no. 86, including pages 25–48, was issued February 26, 1906.*

VIOLA SAGITTATA × SEPTEMLOBA, AND LEAVES OF PARENT SPECIES.

Viola fimbriatula × septemloba (V. Mulfordae).




VARIABLE LEAVES OF VIOLA FIMBRIATULA × SAGITTATA.

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